

NEW GENUS AND SPECIES OF PUFFERFISH (TETRAODONTIDAE) FROM NORFOLK ISLAND, SOUTHWEST PACIFIC

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ABSTRACT

A new genus and species of tetraodontid pufferfish (*Pelagocephalus coheni*) is described, based on a specimen presumably collected by a white tern at Norfolk Island, southwest Pacific. The new species is perhaps endemic to the Norfolk Island region in an offshore semi-pelagic habitat. It differs from all other tetraodontid plectognath fishes in two respects by the following: (1) the ventral portion of the parasphenoid under the orbit is divided into a pair of ventrolaterally directed flanges forming a thin palate over the rear of the oral cavity, rather than being a single vertical plate in the midline as in other pufferfishes; (2) the nasal apparatus is an open, flat, relatively unornamented disk flush with the surface of the surrounding skin, rather than being a short to long tube with one or two nostrils, a paired or single tentacle, or an open large elaborate cup as in other pufferfishes.

The type and only specimen of a remarkable new genus and species of pufferfish, *Pelagocephalus coheni*, was found by John Disney of the Australian Museum, Sydney (AMS), during an ornithological expedition in 1968 to Norfolk Island in the southwest Pacific. The fish, of 107 mm total length, was beneath a tree which contained a nest of a white tern, *Gygis alba*. The pufferfish was moist and showed no indication of having been regurgitated—it had probably dropped from the bill of the tern, near its nest. The fish was taken to the Department of Ichthyology of the Australian Museum, where its uniqueness was recognized.

We have been hesitant to describe a new genus and species based on only a single specimen, and have waited several years to do so, hoping that additional specimens of it would become available. This has not been the case, but because we consider the specimen to be unique, we have decided to describe it at this time.

The specimen is relatively slender and elongate, typical of those few species of tetraodontids that live a pelagic or semi-pelagic open-ocean existence far offshore, such as two species of *Lagocephalus*—the circumtropical *lagocephalus* and the Indo-Pacific *scleratus*. However, one external feature of the new species that is unique among the plectognath fishes is the nasal apparatus, which is in the form of a single, open, relatively simple flat rounded plate on each side of the snout just in front of the eye. All other plectognaths have one or two distinct nostrils on each side, either only slightly upraised above the surface or in a prominent tube, or a paired or single flap or tentacle, or a single nasal cup variously ornamented with ridges, folds, or flaps.

To ascertain if this specimen possessed any unique internal characters, we carefully skinned the specimen after photographs were taken and charcoal wash drawings were made. The skin and viscera are preserved in alcohol. To study its osteology, the body was processed as an alizarin-stained and potassium hydroxide-glycerine-cleared specimen. The skeleton contains a unique feature, at least to the plectognaths, in the form of the ventral region of the parasphenoid under the orbit. In other plectognaths this part of the parasphenoid is a vertical plate of varying thickness, and it is always in the midline, while in the new species it is a pair of thin flanges directed ventrolaterally, forming a roof over the rear of the oral cavity.

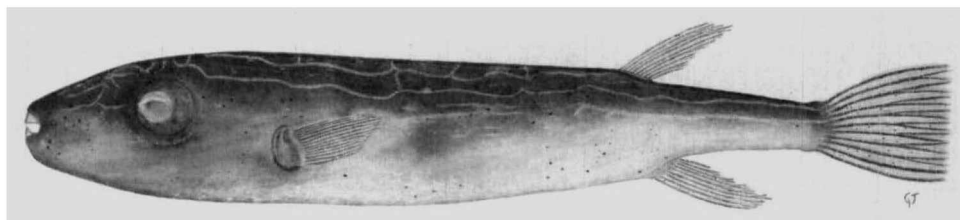


Figure 1. Lateral view of holotype of *Pelagocephalus coheni* Tyler and Paxton new species, AMS I.15601-001, 91.5 mm SL, Norfolk Island.

Pelagocephalus new genus

Diagnosis.—Same as for *P. coheni* new species.

Type Species.—*P. coheni* new species described herein.

Pelagocephalus coheni new species

Diagnosis.—Unique among the plectognaths by its plate-like nasal apparatus and bifurcate ventral flange of the parasphenoid.

Type Specimen.—Holotype and only known specimen, AMS I.15601-001, 91.5 mm SL, ripe female, collected by John Disney on 27 November 1968 on the ground beneath a tree containing a nest of the white tern, *Gygis alba*, at the Melanesian Mission, 0.7 km inland from the central western coastline of Norfolk Island in the western South Pacific Ocean, approximately midway between New Zealand and Australia.

Etymology.—*Pelagios*, of the sea, in allusion to the envisioned offshore, open-water habitat of the streamlined fish; *cephalus*, head, in allusion both to the sleek head and to the similarity of the name with that of *Lagocephalus* (rabbit head; appropriate for most species, but not for the two which are pelagic), one of the several genera closely related to it. The new species is named in honor of Dr. Daniel M. Cohen, Director of the National Systematics Laboratory of the National Marine Fisheries Service, Washington, D.C., a collector of many invaluable Indo-Pacific fishes for the use of others, and a benefactor of both of the authors on many occasions.

Description

Meristics.—Dorsal and anal fins both 9, first and last ray unbranched, other rays branched, first ray well-developed; pectoral fin 14 on both sides, upper two rays unbranched on both sides and lowermost ray unbranched on left side only, other rays branched; caudal fin 11, uppermost ray and lowermost two rays unbranched, other rays branched; gill rakers laterally on first arch 10 on one side, including one rudiment above and below, and 9 on other side, including one rudiment below; vertebrae 17, with 8 abdominal and 9 caudal.

Measurements.—The following measurements in mm are followed in parentheses by their equivalents in percent SL. Head length from tip of upper jaw to upper edge of gill slit 31.4 mm (34.3); head depth 16.0 mm (17.5); horizontal diameter of eye 7.2 mm (7.9); snout length 14.1 mm (15.4); length of postorbital region of head 10.0 mm (10.9); distance between snout and dorsal fin origin 68.2 mm (74.6);

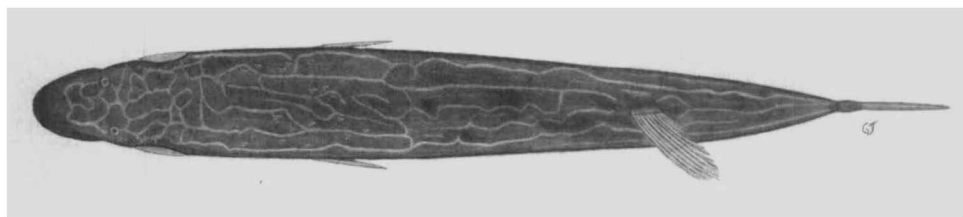


Figure 2. Dorsal view of holotype of *Pelagocephalus coheni*.

distance between snout and anal fin origin 74.7 mm (81.6); distance between snout and anus 68.5 mm (74.9); least width of bony interorbital 8.1 mm (8.9); greatest width of head posteriorly 13.3 mm (14.5); greatest width of jaws between outer edges of maxillaries 8.0 mm (8.7); diameter of nasal plate 1.6 mm (1.8); distance between medial edges of nasal plates 3.4 mm (3.8); distance between left eye and left nasal plate 3.3 mm (3.7); distance between right eye and right nasal plate 4.1 mm (4.5); depth of body at dorsal fin origin and about at anus 14.0 mm (15.3); distance between dorsal and anal fin origins 14.4 mm (15.8); caudal peduncle length from end of anal fin base to middle of caudal fin base 15.6 mm (17.1); caudal peduncle length from end of anal fin base to lower edge of caudal fin base 14.6 mm (16.0); caudal peduncle depth just behind anal fin base 9.8 mm (10.7); caudal peduncle depth just in front of caudal fin base 6.3 mm (6.9); dorsal fin length 12.8 mm (14.0); anal fin length 11.8 mm (12.9); pectoral fin length 10.5 mm (11.5); caudal fin length 15.7 mm (17.2); length of dorsal fin base 4.5 mm (5.0); length of anal fin base 4.5 mm (5.0); length of pectoral fin base 4.7 mm (5.1).

Color Pattern.—Most of head and upper half of body medium tan with very pale tan lines and reticulations, ventrum also pale tan; small irregularly rounded dark tan to blackish spots scattered everywhere along body, least so on ventrum; very pale tan markings on dorsum tending to be more linear on back, although with bifurcations and anastomoses, than on head, where pattern is more reticulate; fins relatively pale, except for presence of dark tan to blackish spots.

Nasal Apparatus.—Plate-like nasal apparatus scarcely upraised above surrounding surface, the edges only slightly curled upward along some portions of periphery; surface of plate more irregular than that of surrounding skin, but otherwise differing from it mainly in seeming to be demarked in petal-like arrangement (as in fully opened and flattened wilted rose); curved edges of petal-like markings

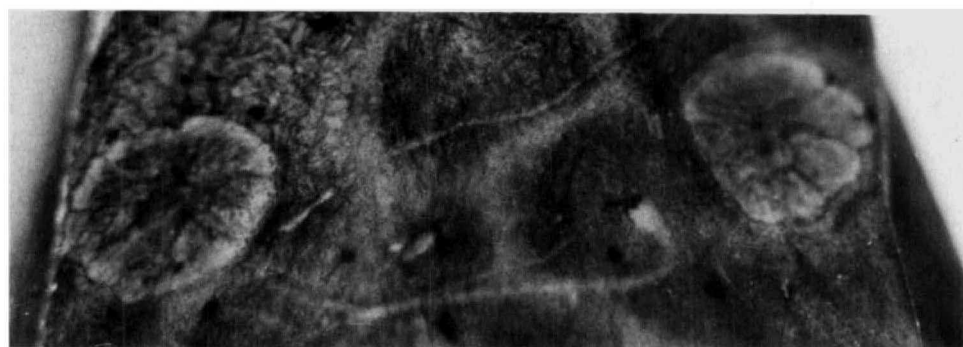


Figure 3. Dorsal region of snout to show the unique flattened plate-like nasal apparatus, one to either side, of the holotype of *Pelagocephalus coheni*.

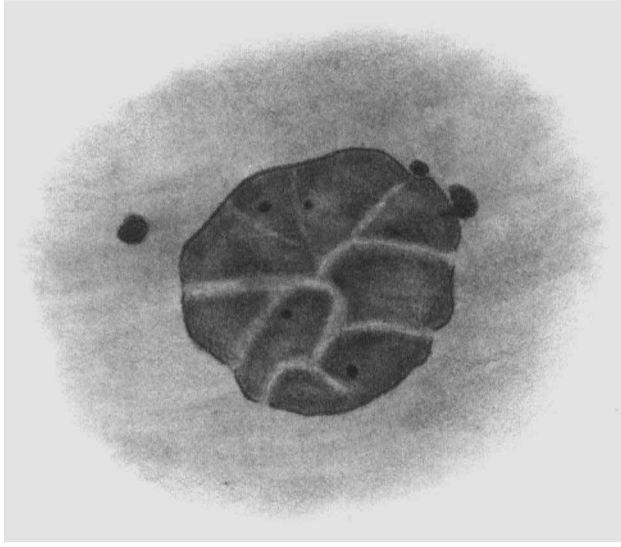


Figure 4. Right nasal apparatus of the holotype of *Pelagocephalus coheni*.

more darkly pigmented than rest of plate, except for dark tan to blackish spots on both plate and surrounding skin; petals radiating out from irregularly circular central region that is slightly more upraised than surrounding nasal plate surface; olfactory nerve entering plate at central region; form of nasal apparatus apparently in natural state and not accountable to possibly partially dried out superficial condition of type specimen when collected.

Other External Features.—Single lateral line on body curving gently downward from head over region of pectoral fin and coursing to middle of base of caudal fin; no keel of skin along ventrolateral curve of body, with which in some other tetraodontids a second of two lateral lines is associated; skin spines present only on belly; anal fin origin relatively posterior in position, just behind rear end of dorsal fin base.

Ovary.—Paired, bilobed, with pale eggs of 0.5 mm diameter.

Osteological Features

Parasphenoid.—Paired ventrolaterally directed wings of parasphenoid, unique among plectognaths, forming weak palate over roof of oral cavity in region under orbit; palate widest posteriorly and tapering gradually anteriorly to join main rod-like portion of parasphenoid at front of orbit in midline (ventral region of parasphenoid under orbit in all other plectognaths in a simple midline plate of varying thickness).

Discussion of Parasphenoid.—The palatal roof formed by the ventrolateral wings of the parasphenoid in the new species occupies a position which in other plectognaths is formed by either the medially curved dorsal regions of the mesopterygoid and metapterygoid, or by a tough sheet of fibrous tissue, or by some combination of these. The distinctive ventrolateral wings of the parasphenoid of the

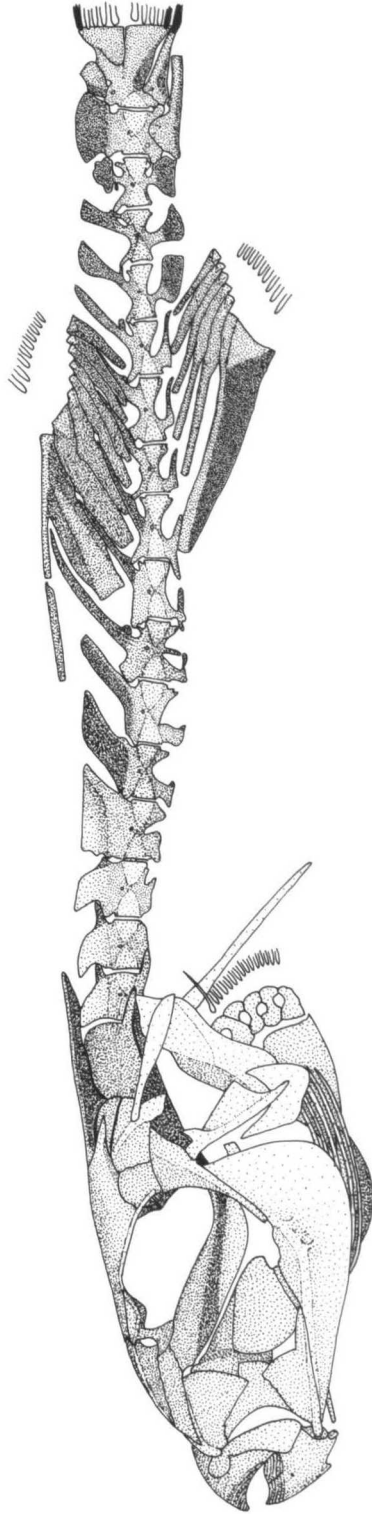


Figure 5. Lateral view of the entire skeleton of the holotype of *Pelagocephalus coheni*.

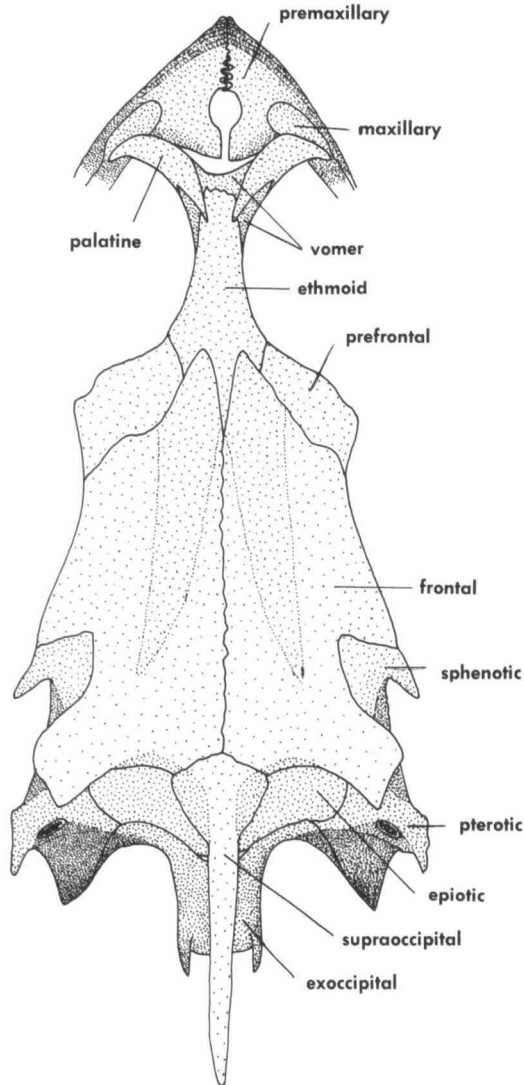


Figure 6. Dorsal view of the skull of the holotype of *Pelagocephalus coheni*.

new species and of their place of origin from the main shaft-like portion of the bone have been particularly carefully examined to be sure that they are not some unaccountable artifact of the perhaps partially but only slightly dried-out condition of the type specimen when collected on the ground. The structure of the parasphenoid gives every indication of being in a natural state. Moreover, examination of museum specimens of dried tetraodontid skulls of numerous species over a period of many years has never brought to light a specimen with a parasphenoid ventral flange which is bifurcate into ventrolateral wings. Thus, the form of the parasphenoid beneath the orbit is a natural and unique feature of the new species, just as is its nasal apparatus.

Discussion of Other Skeletal Features.—The configuration of the dorsal surface of the skull has been used (Hollard, 1857; Gill, 1892; Fraser-Brunner, 1943; Le

Danois, 1959; Tyler, 1979) as an important phylogenetic indicator among tetraodontid fishes.

Unfortunately, the dorsal surface of the skull in the new species is not much out of the ordinary for a large segment of other relatively generalized puffers. The frontals are moderately wide and taper gradually forward, becoming much narrower only anteriorly between the prefrontals. The frontal forms most of the lateral edge of the orbit, as in most other tetraodontids, with the rear of the orbit bounded by the sphenotic and the forward by the prefrontal. The prefrontal and sphenotic are of moderate to slightly less than average size. The size of the ethmoid is moderate and its shape generalized. The frontal has one somewhat unusual feature in that it is extended posterolaterally as a moderately long wing toward the posterolateral edge of the pterotic, above the surface of the antero-medial region of the pterotic, forming a broadly open fossa beneath the wings. Similar posterolateral wings of the frontals are moderately developed in some species of *Sphoeroides* and are moderately to well-developed in all species of *Lagocephalus*.

Elsewhere in the skull, there is only a slight trace of a dorsal roof to the myodome. The medial prongs from the prootic above the parasphenoid, which in some other tetraodontids represent the remains of the dorsal roof (Tyler, 1963), are only slightly evident. The pterosphenoids from either side do not meet in the midline and are not far distant to the frontals. The dorsal edge of the shaft-like portion of the parasphenoid in the region of the orbit does not have a dorsally directed flange in the interorbital septum, as some other tetraodontids do, which contacts the frontals to form a vertical buttress to the skull. There are no inner trituration teeth in the upper jaw, while such are often present in other tetraodontids. The first pharyngobranchial bears eight or nine small but distinct teeth, the second pharyngobranchial has nine well-developed teeth, and the third pharyngobranchial has seven well-developed teeth. There is no interhyal and only a single hypohyal. The postcleithrum seems to be formed of a single piece, and the small uppermost pectoral fin ray is composed of two equal halves.

In the axial skeleton there are complete haemal arches on the third and on the fifth to eighth abdominal vertebrae, while the caudal skeleton is that most typical of tetraodontids, with an autogenous haemal spine of the penultimate vertebrae, a free parhypural, the lower hypurals fused to themselves but free from the centrum and its urostylar projection, and a free epural obliquely placed. A single supraneural element of moderate length is present in the midline just in front of the first basal pterygiophore of the dorsal fin.

Comparisons With Other Genera

Lagocephalus.—In general countenance the new species seems most closely related to the two pelagic species of *Lagocephalus* (*lagocephalus* and *scleratus*), with which it shares a similarly elongate and streamlined body with relatively smooth spineless skin and, overall, a similar ocean-going appearance. *Lagocephalus lagocephalus* has, like the new species, spines only on the belly, and *L. scleratus* has them on the belly as well as some on the back in front of the dorsal fin, while one species, *L. inermis*, is entirely naked.

The new species differs externally from all species of *Lagocephalus* (six species studied, see Tyler, 1979) by having the nasal apparatus as a low, flat, open, relatively unornamented plate rather than as a short tube with two nostrils, and a highly folded inner olfactory epithelium (least folded in *scleratus*) and also by having only a single lateral line and no ventrolateral body skin ridge rather than

two lateral lines, the lower of which is associated with a skin ridge. The new species also has a short-based dorsal and anal fin of nine rays each, while *Lagocephalus* has these fins longer-based and of 10 to 15 rays each (with one of the pelagic species, *scleratus*, having the fewest rays; 11 dorsal and 10 anal). The new species has the first ray of the dorsal and anal fins relatively well-developed and obvious externally, as in most other tetraodontids, while in *Lagocephalus* the first ray of each fin is reduced to a nubbin, which is usually overlooked and uncounted in external descriptions. In the new species the anal fin origin is just behind the base of the dorsal fin, while in *Lagocephalus* the anal fin origin is under the dorsal fin base, usually between the middle and front of the base.

The new species differs internally from all species of *Lagocephalus* in several ways in addition to the shape of the parasphenoid. In *Lagocephalus* there are posteriorly directed prong-like processes of the last basal pterygiophore of the dorsal and anal fins just beneath the skin, while such processes are absent in the new species and in all other tetraodontids. Although trituration teeth are always present inside the upper jaw in *Lagocephalus*, they are absent in the new species. In *Lagocephalus* an interhyal is always present, but absent in the new species. In *Lagocephalus* none of the abdominal vertebrae have complete haemal arches, but in the new species several of these vertebrae have complete arches. In *Lagocephalus* the epural is placed almost horizontally (i.e., in an anteroposterior plane), while in the new species and in all other tetraodontids the epural is placed obliquely to the vertebral axis. The $8 + 9 = 17$ vertebral formula of the new species is similar to that of three of the six species of *Lagocephalus* studied, whose other three species modally have 18 or 19 vertebrae. The moderate length of the superaneural element in the new species is similar to that of one (*inermis*) of the species of *Lagocephalus*, while the others have the supraneural relatively long (four species) to extremely long (the pelagic *lagocephalus*). In the new species and in two species of *Lagocephalus*, remnants of the dorsal roof of the myodome are essentially absent; in two other species of *Lagocephalus* these remnants are moderately developed as prootic prongs, and in two other species the prongs are extremely well-developed, at the maximum for the family. In the new species, teeth are present on the first pharyngobranchial, as they are in three out of the six species of *Lagocephalus* studied. The posterolaterally directed wings of the frontals are moderately developed in the new species and in two species of *Lagocephalus*, while the other four species of *Lagocephalus* have these wings very well-developed, at the maximum for the family. The new species and all but one (*laevigatus*) of the species of *Lagocephalus* lack the dorsal hypohyal.

Thus, the internal structure of the new species does not show an especially close affinity with that of *Lagocephalus*, even though externally it seems closest in appearance to certain members of that genus. None of the most specialized characters of the new species (structure of the nasal apparatus and parasphenoid) and of *Lagocephalus* (basal pterygiophore prongs and horizontal epural) are shared, while one relatively specialized character (the presence of at least moderately developed posterolateral wings on the frontals) that they do share is found, among the other tetraodontids, only in *Sphoeroides*, a genus speculated to be closely related to *Lagocephalus* (Tyler, 1979).

Sphoeroides.—Considering all of the same characters discussed above in relation to the new species and *Lagocephalus*, it seems that *Sphoeroides* has more similarity to the new species than does *Lagocephalus*, except in general external appearance, as described below.

None of the species of *Sphoeroides* is especially elongate and streamlined, and most of them (11 species studied, see Tyler, 1979) have spines on both the back

Table 1. Summary of major anatomical features of *Pelagocephalus* and related genera

Character	<i>Pelagocephalus</i> *	<i>Lagocephalus</i>	<i>Sphoeroides</i>	<i>Fugu</i>	<i>Torquigener</i>	<i>Amblyrhynchotes</i>
Vertebrae	17	17-19	17-20	19-23	19-21	19-20
Abdominal vertebrae with complete haemal arches	some	none	some	some	some	some
Epural position	oblique	horizontal	oblique	oblique	oblique	oblique
Supraneural length	moderate	moderate to extremely long	short to moderate	moderate	moderate	moderate
Trituration teeth in upper jaw	absent	always present	always present	always present	always present	usually present
First pharyngo-branchial teeth	present	often toothless	usually present	present	present	present
Parasphenoid dorsal lobe in orbit	present	often present	usually absent	always present	always present	always present
Interhyal	absent	always present	usually absent	absent	absent	absent
Myodome dorsal roof remnants	absent	moderate to well-developed	absent to well-developed	absent	absent	absent
Last basal pterygiophore posterior prongs	absent	moderate to well-developed	absent	absent	absent	absent
Dorsal hypohyal	absent	usually absent	usually present	absent	sometimes present	usually absent
Dorsal and anal fin rays	9	11-15	7-9	12-18	7-14	7-11
First dorsal and anal fin rays	well-developed	poorly developed	well-developed	well-developed	well-developed	well-developed
Anal fin origin	behind dorsal fin base	under dorsal fin base	under dorsal fin base	under dorsal fin base	under dorsal fin base	usually under dorsal base (sometimes in front; sometimes at rear)
Skin spines	belly only	naked to spines on back and belly	naked to spines on back and belly	naked to spines on back and belly	usually spines on back and belly	usually spines on back and belly

Table 1. Continued.

Character	<i>Pelagocephalus</i> *	<i>Lagocephalus</i>	<i>Sphaeroides</i>	<i>Fugu</i>	<i>Torquigener</i>	<i>Amblyrhynchotes</i>
Lower lateral line	absent	always present	absent, except sometimes with remnants	always present	always present	usually present
Caudal peduncle lower upraised skin ridge	absent	always present	usually absent	usually absent	usually absent	usually absent
Olfactory epithelium surface	smooth	highly folded	usually smooth; sometimes highly folded	moderately to highly folded	moderately folded	moderately folded

* New genus unique by bifurcate ventral flange of parasphenoid and by nasal apparatus as a flattened open disk.

and belly, although two species are normally entirely naked—the deep-water, chunky, and flabby-bodied *pachygaster* and the shallow-water, more typical appearing *angusticeps*. Other than this, however, the new species differs externally from *Sphoeroides* mainly by possession of a flat plate-like nasal apparatus, rather than of the more normal tube with two nostrils found in both *Lagocephalus* and *Sphoeroides* and related genera such as *Amblyrhynchotes*, *Fugu*, and *Torquigener*. In most species of *Sphoeroides* the inner olfactory epithelium is no more ornamented than in the new species, but a few species (most notably *pachygaster*) have the epithelium thrown up into as many folds as in most species of *Lagocephalus*.

In the new species and in most species of *Sphoeroides* there is a single lateral line, while a few species of *Sphoeroides* often have incomplete segments of an additional lower lateral line present. There is no ventrolateral body skin ridge in the new species and none in most species of *Sphoeroides*, although a few species of the latter do have the skin keel developed, especially if segments of the lower lateral line are present. The new species and *Sphoeroides* both have the dorsal and anal fins short-based, the 9 rays in each fin of the new species being similar to the 7 to 9 rays of *Sphoeroides*. In both cases the first ray of each fin is relatively well-developed and obvious externally. The anal fin origin of the new species, being behind the dorsal fin base, is placed somewhat farther posteriorly than in *Sphoeroides*, in which it is under the dorsal fin base, although sometimes under the far rear portion of it.

In addition to the shape of its parasphenoid, the new species differs internally in a few other ways from *Sphoeroides*. In the new species there are no trituration teeth, but they are always present in the upper jaw of *Sphoeroides*, just as in *Lagocephalus*. These teeth are also present in the lower jaw in four species of *Sphoeroides*. There is no dorsal hypohyal in the new species, but it is present in most species of *Sphoeroides*, being absent only in *greeleyi* and *trichocephalus* (specific names here and elsewhere in accordance with Shipp, 1974). In the new species and in most species of *Sphoeroides* there is no interhyal, which is usually present only in *greeleyi*, *maculatus*, and *pachygaster*. In the new species and in most species of *Sphoeroides* there is not trace of the dorsal roof of the myodome, while prootic prongs representing its remnants are at least relatively distinct although small in *angusticeps*, *greeleyi*, and some *maculatus*, but well-developed in *dorsalis*. The vertebral column of the new species, with a formula of $8 + 9 = 17$, is similar to that of most species of *Sphoeroides*, which have 17 or 18 vertebrae, while a few species have 19 or 20, and both the new species and all species of *Sphoeroides* have complete haemal arches on some of the abdominal vertebrae. In the new species and in *Sphoeroides* the epural is placed in the normal oblique position and the supraneural element is of moderate length, or short, as in several species of *Sphoeroides*. In the new species and in all but one species of *Sphoeroides*, a dorsal lobe of the parasphenoid in the interorbital septum contacting the frontals is absent, being present only in *annulatus*. Neither the new species nor any species of *Sphoeroides* has posteriorly directed processes from the last basal pterygiophore of the dorsal and anal fins, such as are found in *Lagocephalus*. In the new species and in *Sphoeroides*, posterolateral wings of the frontals toward the pterotics are moderately developed or absent. In the new species and in all but one species of *Sphoeroides* there are teeth on the first pharyngobranchial, these being absent only in *pachygaster*.

Other Related Genera.—There are three other genera of tetraodontids that seem, on the basis of external and internal characteristics, to be closely related to the new species. These are relatively generalized Indo-Pacific genera thought to be

allied to and possibly derived from a *Sphoeroides*-like ancestry much as is *Lagocephalus* (Tyler, 1979). These three genera are *Fugu* (three species studied), *Torquigener* (two studied), and *Amblyrhynchotes* (three studied). All of these genera have a nasal apparatus of a tube with two nostrils similar to that of *Sphoeroides* and *Lagocephalus* (except that the inner olfactory epithelium is always relatively smooth, instead of highly folded as in *Lagocephalus* and in one species of *Sphoeroides*) in contrast to the flat plate of the new species, and in all of these genera the ventral flange of the parasphenoid is normal, rather than with ventrolateral wings as in the new species. *Fugu*, *Torquigener*, and *Amblyrhynchotes* differ from the new species and from most species of *Sphoeroides* by having two lateral lines on the body rather than only one; the lower line is usually associated with a ventrolateral body skin fold just as in *Lagocephalus* (often absent in *Amblyrhynchotes*). While the new species has spines only on the belly, there normally are spines on both the back and belly in *Torquigener* and *Amblyrhynchotes* and in most species of *Fugu*. However, two species of *Fugu* (*chrysops* and *vermicularis*) are naked. Although the new species lacks a dorsal lobe of the parasphenoid contacting the frontals in the orbit, this dorsal lobe is always present in *Fugu*, *Torquigener*, and *Amblyrhynchotes*. With 17 vertebrae, the new species has several fewer units than: *Fugu*, with 19 to 23, and usually 21 or more; *Torquigener*, with 19 to 21; and *Amblyrhynchotes*, with 19 to 20. Whereas there are no trituration teeth in the new species, these are present in *Fugu* and *Torquigener*, and in two of the three species of *Amblyrhynchotes* studied (absent in *richei*). The anal fin origin in the new species is farther posterior than in these three genera, in which it is under the dorsal fin base, although sometimes under the rear of that base. The nine dorsal and anal fin rays of the new species are not much different than that of *Torquigener*, ranging from 7 to 14, and *Amblyrhynchotes*, ranging from 7 to 11, while they are fewer than in *Fugu*, ranging from 12 to 18. In all of these the first dorsal and anal fin rays are well-developed and obvious externally.

Fugu, *Torquigener*, and *Amblyrhynchotes* otherwise have many internal similarities to the new species, to about the same extent as *Sphoeroides*. The new species and *Fugu*, *Torquigener*, and *Amblyrhynchotes* all: possess teeth on the first pharyngobranchial; lack prominent posterolateral wings of the frontals toward the pterotics; lack posteriorly directed prongs on the last basal pterygiophores of the dorsal and anal fins; lack an interhyal; possess complete haemal arches on some of the abdominal vertebrae; have the epural placed in a normal oblique position; lack the dorsal hypohyal, except present in *A. piosae* and *T. pleurostictus*; possess a moderately developed supraneural element; lack remnants of the dorsal roof of the myodome.

Relationships.—Tyler (1979) suggests that, of the above genera, *Sphoeroides* is the most generalized, and that a *Sphoeroides*-like stock probably gave rise on the one hand to *Lagocephalus* and on the other to the closely related group of genera consisting of *Fugu*, *Torquigener*, and *Amblyrhynchotes*.

Externally, the new species seems closest to the pelagic forms of *Lagocephalus*, while internally it is more similar to *Sphoeroides*, but not much more so than to *Fugu*, *Torquigener*, and *Amblyrhynchotes*. Table 1 presents a summary of the anatomical features of *Pelagocephalus* and its related genera.

We speculate that the new species is a strangely specialized derivative of an early *Sphoeroides*-like stock in the Indo-Pacific related to the same *Sphoeroides*-like line which gave rise to *Lagocephalus* before becoming extinct in the Indo-western Pacific, to be found only as the Recent *Sphoeroides* in the eastern Pacific and the Atlantic (to South Africa).

DISCUSSION

We have searched to no avail for additional museum specimens of the new species in Australian, European, and American collections, and an ichthyological survey of Norfolk Island in 1975 by Douglass F. Hoese of the Australian Museum did not find any specimens of it. It has apparently eluded fish collecting by nets, traps, and rotenone-like poisons, and has only fortuitously become available through the probable agency of a bird. Because of its streamlined appearance and its manner of collection, the new species may well be a pelagic or semi-pelagic open-water form not found inshore where most ichthyological collections are made. The new species may also have a relatively restricted western Pacific distribution in the Norfolk Island region and a low population density, all of which would account for its rarity in museum collections and our dependence on a bird for its collection.

Endemism of many groups of marine organisms in this region of the Pacific is well known, although of debatable degree and means of quantification (as discussed by Briggs, 1966, 1969; McDowall, 1968). A new species of tetraodontid pufferfish endemic to Norfolk Island and its environs would not be so remarkable in this systematically troublesome group much in need of revision on the generic and specific levels were it not for the fact that the new species appears to be an open-water pelagic form that could be expected to have a wider distribution. However, the new species has short-based dorsal and anal fins, which may indicate that it is not fully adapted to pelagic life. It thus may have a relatively restricted offshore semi-pelagic existence in a limited western South Pacific region encompassing Norfolk Island.

The new species is not among the fishes known either by names currently recognized as valid or by any of their supposed synonyms as reported from Norfolk Island by Waite (1910, 1916) and Fowler (1953), or from surrounding oceanic island groups such as Lord Howe Island and Middleton and Elizabeth Reefs or from New Zealand as reported by Richardson (1843), Clarke (1897), Whitley (1934, 1968), Andrews (1970), Randall (1976), and Allen et al. (1976), nor from the better known tetraodontid fauna of Australia. We obviously do not believe that a name of any nomenclatural variety is available in the literature for the species described here as new.

There are numerous reports in the literature of young pufferfishes being eaten or found in the stomach contents of large predaceous fishes, including flounders (pleuronectids) experimentally offered young Atlantic puffers (Beebe, 1932), or, in the general area of the world under consideration with the new species, flat-heads (platycephalids) and flounders observed regurgitating young puffers in Australia (Hutchison, 1972). Of greater interest, however, are the few reports of birds preying on pufferfishes, including the comments of Beebe (1924) on the difficulty that gulls have in trying to eat puffers at Galapagos in the eastern Pacific. Upon attack the puffers become inflated and bob at the surface, making it difficult for them to be captured. Recher and Recher (1968) made extensive observations of herons preying on a variety of fishes, including western Atlantic *Sphoeroides* puffers, and, like Beebe, they found that the ability of puffers to increase their girth with either air or water did decrease predation, especially with increasing size of the puffer, with the young being more prone to predation. Moreover, Stranger (1970) has shown that in Australia a local common inshore pufferfish, *Torquigener pleurogramma*, known to be poisonous, is safely eaten regularly by the silver gull, *Larus novaehollandiae*. This was verified by both field observations and experimentally. The gulls are tenacious in holding onto their pufferfish prey when bullied by large birds, and usually do not loose their captured pufferfish.

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